QUIZ 1 DAA (H)

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SOPJ Account

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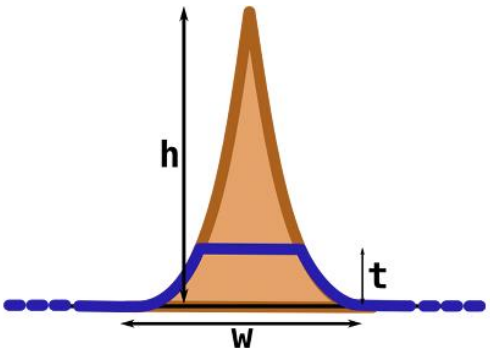
SPOJ : 7704 CIVIL – Civil Engineering

Title : Civil Engineering

Problem Description :

In the first problem, we take a role become a civil engineering who is build a tunnel through mountain. The mountain have a basic basic geometric shapes, that the shape is kinda like arrow point.



From the conclusion, we will understand that h is height of the mountain, w is width of the mountain, and t is heigh of the tunnel. From both side of the tunnel has a parabolic line($y = ax^2 + bx + c$ for some a,b,c). Because we want build a tunnel, of course we need a cost to build it. That cost is simplified as f. The lower the tunnel, the higher the cost. As a civil engineer, you should make a program that calculated that we can build a tunnel with cheaper cost as possible.

Problem Abstraction :

- **Observation**
  - This program make a good calculation to find ideal height to the tunnel to decrease high cost production
  - We have a look that side of the mountain have a parabolic shape that have a formula $y = ax^2 + bx + c$
  - We only have a 3 input number that is height of the mountain, width of the mountain, and cost of production where cost is calculated per meter
  - Each number are sctricly positive floating point
  - Input file ends where all number are zero
  - This calculation need a mathematical operation, especially calculus techniques
- **Theory References**

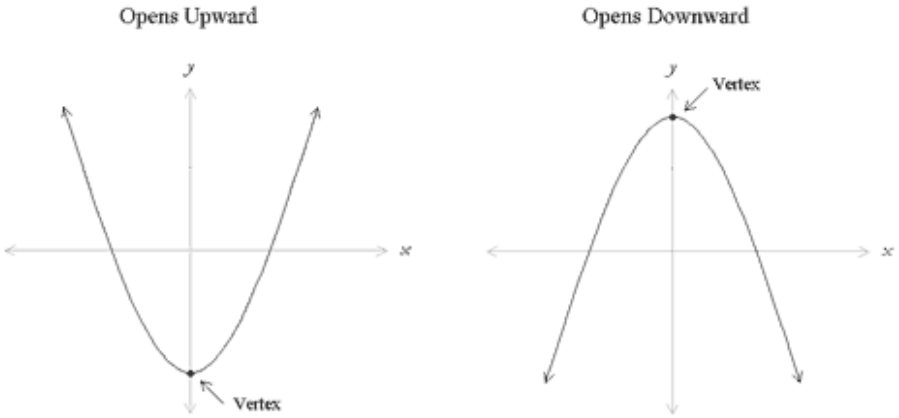
- Understanding about theory of parabolic equation
- Understanding about integral calculation
- Understanding about mathematical principle
- Understanding about quadratic calculation

Solution

First of all, we must understand what is shape of the mountain. If we look closer, the mountain have a sharp point at the top and wide each side of it. Consider we are using parabolic equation, lets understanding this formula.

$$y(x) = ax^2 + bx + c,$$

This is standart from of quadratic function contain a,b, and c are constants and $a \neq 0$. The coefficient a in this formis called the leading coefficient because it is associated with the highest power of x . Quadratic function are non linear functions that are graphically represented by parabolas and have a characteristic U shape and open either upward or downward as shown below.

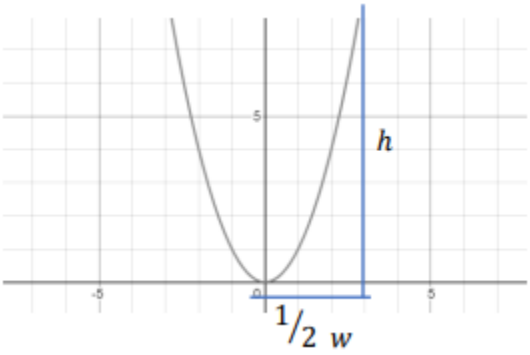


By inspecting a quadratic equation in standart form, we can get that the leading tells you the direction the parabola opens, especially

if $a > 0$, the parabola opens upward

if $a < 0$, the parabola opens downward.

Lets we change this into mountain shape. From the reconstruct, we have a shape like this.



https://www.mathsisfun.com/algebra/quadratic-equation.html

From that point, that we have an information that the mountain has a peak point. So we have to take another quadratic formula that

$$y = a(x - x_p)^2 + y_p$$

After that, we have to know that we calculate length hof the curvature of parabolic using integral formula

$$= \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$$

https://www.konsep-matematika.com/2016/03/menentukan-panjang-busur-dengan-integral.html

Finally, we have formula that we needed is

$$t = \frac{(f^2 - 1)\, w^2}{16h}$$

Source Code :

```
#include <iostream>
#include <iomanip>
#include <cmath>

using namespace std;

int main(){
    // Declare variable of height (t), width(w), and t is heigh of the tunnel
    double h,w,t;
    //Use EOF that while operation still running from user input
```

```
    while(scanf("%lf %lf %lf",&h,&w,&t) != EOF){
        //return 0 value if height of the mountain is 0
        if(h == 0) return 0;
        //input the number into the formula
        double ans = (((pow(t,2))-1) * (pow(w,2)) / (16*h));
        cout << fixed << setprecision(3) << ans << endl;
    }

    return 0;
}
```

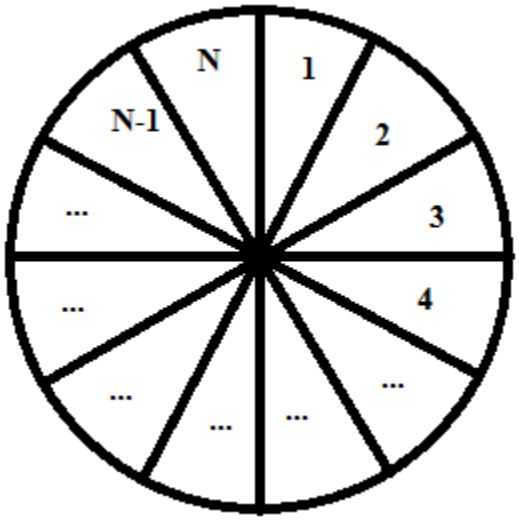
Proof that finish the SPOJ

TamaTC: submissions
Civil Engineering

ID		DATE	PROBLEM	RESULT	TIME	MEM	LANG
30989390	☐	2023-03-10 08:46:50	Civil Engineering	**accepted** edit ideone it	0.01	5.3M	CPP14
30989269	☐	2023-03-10 08:29:36	Civil Engineering	**accepted** edit ideone it	0.01	5.3M	CPP14

SPOJ : 12746 CRCLE_UI – Colorful Circle (EASY)

Title : Colorful Circle



Problem Description :

So from the image above us, we have a cirle that have multiple section inside of it. Each section has a number start from number 1 until n number. We also have a color where eacch color is use to coloring each section of it. Eah section has a different color. Make a program that calculated all possibilities to draw the color of all section inside the sircle.

Problem Abstraction :

From the information we get, we have

t = total case

n = how many section

k = color of each section

Modulo = Set into 10^9 + 7

Problem Abstraction :

- Observation
  - This program make a good calculation to find how many the color can be created by total of n section
  - We have a look that the sircle has a many section consider each section has a same value
  - Each color has a different color and nothing same
  - K (color) has number start from 2<K<10^1000
  - N (section) has number start from 1 <N < 10^1000
  - For eacch test ccase, output number can be large, so use a modulo where has a number 10^9+7

- Theory References
  - Understanding about probability and statistical principle
  - Understanding about mathematical principle
  - Understanding about quadratic calculation

Solution :

First of all, we must have a look the result of each test. This test is begin from number 1 into number 5 for study case. For understanding about the solution, we are see that 1 number in (N) is has a result of 0. If we describe a(n) is the total ways to color each section, so we can describe that is no way to make 1 sector turn into many color. It always to be one color. Also if we have a(2), so we can use a recurrences relation to generate recursive pattern. From that, we have a(2) = k * k-1. Look at the table below

N	K	A (N)
1	3	0
2	3	6
3	3	6
4	3	18
5	3	30

N	K	A (N)
1	4	0
2	4	12
3	4	24
4	4	84
5	4	240

K = 3

N	A(N)	Description
1	0	0
2	6	(2 x 3)
3	6	$(2\ x\ 3\ x\ 4)$
4	18	$(2^2\ x\ 3) + (2^1\ x\ 3)$
5	30	$(2^3\ x\ 3) + (2^1\ x\ 3)$

K = 4

N	A(N)	Description
1	0	0
2	12	(3 x 4)
3	24	$(2\ x\ 3\ x\ 4)$
4	84	$(2\ x\ 3^2\ x\ 4) + (3\ x\ 4)$
5	240	$(2\ x\ 3^3\ x\ 4) + (2\ x\ 3\ x\ 4)$

From the result of the table, we have conclusion that each table has a different result based on k (color). As an information from internet, If we used a labelled sector, we can use a inclusion to form sets $A_{i,j}$ of colouring with adjacent sectors that I and j are not equal. So we get the formula is

$$F(n, k) = \sum_{r=0}^{n-1} (-1)^R \binom{N}{R} k^{n-r} + (-1)^N \binom{N}{N} k$$

$$F(n, k) = \sum_{r=0}^{N} (-1)^R \binom{N}{R} k^{n-r} + (-1)^N (k-1)$$

$$\Longrightarrow F(n, k) = (k-1)^N + (-1)^N (k-1)$$

Source : https://www.quora.com/Given-a-circle-that-is-divided-into-N-identical-sectors-and-we-have-k-different-colors-to-paint-it-How-many-ways-can-we-paint-it-under-the-condition-that-no-adjacent-pieces-have-the-same-color

But, the formula i get its only used for n with even number. So, If we use a odd number, then replace the (+) with a (-) .

Now, if we look to N and K.It has very large number, even the long long data type cant hold it. So, instead using standart data type in c++, we are using extension library that hold that number. Introducing the multiprecision library. It can be used to calculate all kinds of mathematical calculations involving integer, rational and floating point types requiring extended range and precision.

Source Code

```
#include<bits/stdc++.h>
#include<boost/multiprecision/cpp_int.hpp>
using namespace boost::multiprecision;
using namespace std;
#define mod 1000000007

cpp_int calc(cpp_int x, cpp_int y){
    // calc function has constructor that x is (k-1) or ans1 and y is n (section)
    cpp_int ans3 = 1;
    //declare ans3 = 1 to make a parameter
    while(1){
        //x y = 2 2 =>  3-1 color 2 section
        //x y = 2 3 =>  3-1 color 3 section
        if(y&1) {
            ans3 = (x*ans3)%mod;
        }
        y>>=1;
        // y /= 2
        if(!y) break;
        x = (x*x)%mod;
    }
    return ans3;
}

int main()
{
    int t;
    // using multiprecision library to expand the number beyond max data type of
c++
    cpp_int n, k,ans1,ans2,ans3;
    //Input user total test case number
    cin >> t;
    //Make a while operation until t is zero
    while(t--){
        //input n and k variable
        cin>>n>>k;
        // understanding that the formula that F(n,k) = (k-1)^n +/- (-1)^n (k -1)
```

```
        // make k-1 into ans to make it simple
        ans1 = (long long)k-1;
        // make (k-1)^2 into ans2 using function calc
        ans2 = calc(ans1,n);
        // understandng that if n is odd, then using - operation. But if
        // n is even, then using + operation
        if(n&1) ans3 = ans2-ans1;
        else ans3 = ans2+ans1;
        // print the result
        cout << (ans3+mod)%mod << endl;
    }
    return 0;
}
```

Proof That Finish The SPOJ

30991756	☐	2023-03-10 15:01:10	Colorful Circle (EASY)	**accepted** edit ideone it	0.29	5.3M	CPP14
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By the name of Allah (God) Almighty, here with I pledge and truly declare that I have solved quiz 1 by my self, didn't do any cheating by any means, didn't do any plagiarism, and didn't accept anybody's help by any means. I am going to accept all of the consequences by any means if it has proven that I have done any cheating and/or plagiarism

Surabaya, 19 March 2023

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